Rendezvous

Where today meets tomorrow

Meanwhile, Back at the Station...

Meanwhile, Back at the Station...

What does shuttle transition and retirement really mean for the International Space Station?

About Those Gaps, Surpluses and the Human Capital Question:

Defining and managing our employee resources through transition is an agency-wide effort.

T&R Progress Report:

An overview of this spring's transition and retirement activities across NASA.

Moving Forward: Jeff Hanley gives his perspective on Constellation's progress.

Getting Ready to Launch the Future:

Some of the shuttle's launch systems are already transitioning over to Constellation.

Coaching in the Shuttle's Fourth Quarter:

Tim Garner's calling some of the key plays in transition management at Marshall.

Weighing In

From Leadership

From The Editor

Archives

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We've reached the point in our transition journey where it has become clear that our program is coming to a close. Last year a "do not preclude" date – April 30, 2009 – was set out in the NASA Authorization Act of 2008. It required that the program assure the "continued safe and effective" flight of the shuttle after 2010, should President Obama delay the shuttle's retirement. That date has come and gone.

In John Shannon's recent message to the shuttle workforce, he clearly defined the budgetary limitations faced by the program and the program's inability to fund the continued capability to fly additional missions in the hope that the program will be extended. Instead, he urged us to stay focused on managing within our limited budget, ensuring that we fly the full shuttle manifest, and achieving the program's mission of completing the assembly of the International Space Station. We have arrived at the point at which, in order to fulfill our mission, we have to protect our remaining budget. This means closing down capabilities and releasing workforce that are not required to fly out the manifest. Letting go of these extraordinary teams and world-class facilities is a difficult and emotional process. But it is one we have to undertake to accomplish our mission.

We have eight remaining flights until we have fulfilled our program's charter. I know that eight flights sounds like just a few, but when considered against the entirety of our program's achievements and the time we have left, eight flights in less than 18 months is an aggressive schedule. With the plan currently in place, the Space Shuttle Program retains the robustness required to complete the assembly of the International Space Station. We can do it. And we can do it with pride in a job well done by a workforce like none other the world has ever known.



Dorothy Rasco
Manager, Space Shuttle Business Office
SSP T&R Lead
Johnson Space Center

The next couple of months are destined to be an exciting, extremely busy and bittersweet time for the shuttle program. Between our last issue and this one, we launched and landed two important missions — STS-119 and STS-125, the long awaited final mission to repair the Hubble Space Telescope. And between this issue and our next one, we will launch STS-127, the 29th mission to the International Space Station to deliver and install the Kibo Japanese Experiment Module Exposed Facility. In a program that has spanned 28 years and 126 missions to date, we're down to single digits now.

In our feature article, "Meanwhile, Back at the Station ..." *Rendezvous* looked into the impact that shuttle retirement is having on the International Space Station and how the station will operate in a shuttle-less environment.

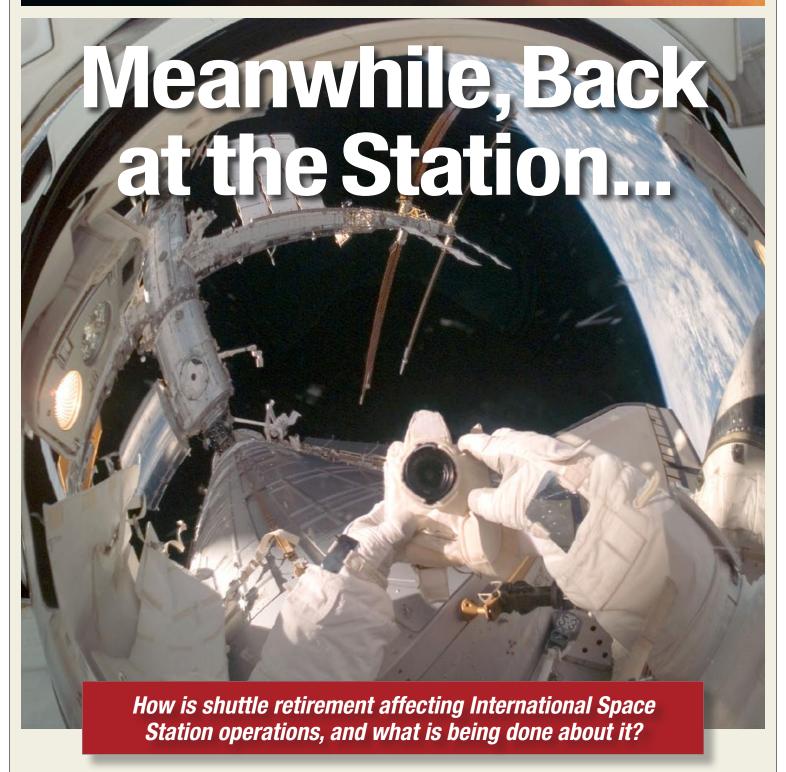
As we near the end of the program, activity has also ramped up in human capital initiatives at all the centers and among the program's contractors. Facilities and equipment are being transferred over for Constellation use, too. In "Gaps, Surpluses and the Human Capital Question," we delved into the challenges of protecting skill sets and providing opportunities throughout the program. In "Getting Ready to Launch the Future," we talked to shuttle and Constellation people about juggling test and launch schedules with modification schedules at Kennedy Space Center and Stennis Space Center. We also had an interesting chat with Tim Garner, a familiar face at Marshall Space Flight Center, who is busy supporting transition activities at the center.

For this issue, T&R Progress Report focused on preparations for Constellation's first flight tests of the Ares I-X and its launch abort system scheduled for later this year. In a related article, we sat down with Jeff Hanley, manager of the Constellation Program, to talk about upcoming challenges and milestones and get a report on the space program's next big step.

In Weighing In: Quips & Quotes, you'll read what we heard in several focus and brainstorm sessions conducted at Marshall and Stennis. Although we found that the limited time left for the program is presenting the shuttle workforce with some heavy-duty issues to grapple with, there is a common chord that runs throughout — that the shuttle program was and is a great place to work, and shuttle people are proud of their considerable achievements. We think you'll find their comments and opinions interesting and thought-provoking.

We encourage you to use the feedback button to tell us what you think or comment on anything you read here. And don't forget to subscribe if you haven't already — if you do, not only will you get our quarterly publication, but you'll also receive our biweekly updates to the *Rendezvous* Web site. We look forward to hearing from you.

Enjoy!



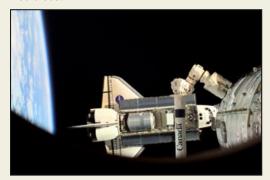
When the nation's Vision for Space Exploration was revealed in January of 2004, it wasn't just the space shuttle workforce that was stunned by the timetable for the close of their program. When the details of our new moon-Mars objectives and the development of the new exploration systems to take us there sank in, the space station family realized that their world had forever changed, too. And like the Space Shuttle Program, they've been working to deal with its implications ever since.

Rendezvous talked with station leadership and its team of logistics and maintenance, procurement and contracts experts, as well as Boeing's station leadership to get a clearer picture of the shuttle transition and retirement challenges station is addressing.

The plan had always been to complete station assembly utilizing the shuttle as its primary cargo transportation system, and continue transporting crews and payloads via shuttle at least four times per year. That all changed in early 2004.

The notion of parking the shuttles after final assembly in 2010 required a major shift in the way the program looked at capitalizing on its considerable investment of time, energy and resources. Steve Elsner, who served as deputy manager of the Program Planning & Control Office for the International Space Station Program for 5 years, pointed out that the impact is not limited solely to American interests, either. It affects the entire international partnership — the Russians, the Canadians, the Japanese and the Europeans.

"By spring 2005, the station program had worked through quantifying the total impact of shuttle retirement on the station's future," Elsner related. "The station's shuttle transition and retirement effort, or STaR, focused on what new requirements would be needed in the absence of shuttle's services, particularly in the area of logistics, maintenance and crew and cargo transportation, and how much these new requirements would cost."



Endeavour approaches the space station. The Raffaello multi-purpose logistics module is clearly visible through the orbiter's open payload bay doors.

The Upmass/Downmass Conundrum

As just about everyone knows in the space program, the shuttle system is unique. It provides the upmass capability required to assemble the station and deliver scientific payloads, and the downmass capability to return the scientific samples and equipment to earth for analysis and/or repair. No other vehicle ever sent into low Earth orbit has been as able to do that.

So, the station program had to consider what it would do without that capability. One area that requires a totally new approach is station maintenance – and this has consequences that are more far-reaching than one might imagine. With shuttle, when a piece of equipment fails on station, a replacement could be "shipped" up to replace it and the failed element could be returned to earth to be evaluated, repaired and placed back in the spares inventory. This return-repair-refly philosophy meant that facilities were set up to receive and repair the

returning equipment. After a certain number of spares were produced, many of the manufacturers were, in effect, turned off. In some cases, NASA took possession of the manufacturing equipment.

In the absence of shuttle, some equipment can be delivered, but only an extremely small portion of it can be returned. The Soyuz accommodates a small amount of downmass cargo in addition to its human payload, and the Progress, of course, doesn't come back at all. The same is true with the Autonomous Transfer Vehicle and the Japanese H-II Transfer Vehicle, known as the ATV and HTV. Both have the required upmass capability, but both burn on re-entry.

But without the ability to deliver and return large payloads, how can we keep the station properly maintained? The station program's logistics and maintenance team completely retooled their thinking and revised its processes. "Return-repair-refly" evolved into "build 'n burn," meaning that spares would be sent up, but failed units would not come down. This is Compartment of the space station during Expedition 18. where the ripple effect started.



A Progress resupply vehicle is docked to the Pirs Docking

"Return-repair-refly" evolved into "build 'n burn."

Needed: New Spares Procurements

With the previous philosophy, it wasn't necessary to stock a large inventory of station parts. But with the new logistics and maintenance philosophy, it becomes necessary to keep a much larger, expendable inventory of these same parts, some of them kept in inventory on the station itself.

Sounds simple, but it isn't. Not by a long shot.

Now the ISS Program team had to go back to negotiate new contracts for spares manufacturing with suppliers that had been turned off years ago. Some of these manufacturers were no longer in a position to participate in the space program.

"We had to go back to manufacturers who had not built spares for station for a long time and try to determine what it would take to restart their [manufacturing] lines, call people back from other programs, rebuild their fixtures and jigs and get their test equipment running again," said Bill Robbins, deputy manager of the station's logistics and maintenance office. "Then we took our requirement and added it to all the other budget impacts from all the other station offices."

"We had to spin up new production," Elsner said. "In the last 18 months alone, we've turned on 14 provisioning item orders."

There were obsolescence issues, too. Parts and equipment used in the original build of the station were no longer available and required a substitute part. Of course, a replacement has to be subjected to a complete material review board cycle in order to be certified to fly on station. More complications.

"We had to spin up new production," Elsner said. "In less than two years, we've turned on 15 provisioning item orders on our Boeing sustaining contract representing more than \$400 million of work that encompasses more than 170 deliverable items."

Drawing on a Dedicated Base

Getting all those contracts in place was the responsibility of Eric Schell who works in the Space Station Procurement Office. Given the shift in logistics and maintenance philosophy, Schell's contract workload increased significantly. Going back and contacting the previous subcontractors was an education in itself, he remembered. Some subs were happy to come back, but others were reluctant.

"NASA's work in general is very unique. It's not like you can use it for anyone else," Schell pointed out. "We're lucky that we have a dedicated contractor base that wants to stick with us."

Schell and the team worked closely with the technical team to determine the spares schedule, how many of which parts are currently on hand and what needs to be produced. Then they embarked on a series of negotiations with contractors and their subs to accommodate the changes.

"Our contractors want to see the goals met and the mission completed."

"Three-way negotiations with just about everyone willing to play ball, that's a great thing," Schell said. "Our contractors want to see the goals met and the mission completed. Still, negotiations are negotiations, and going from repairs to spares requires 17 contract actions. That's 17 orders with Boeing and 10 different manufacturers. That's a variety of group dynamics with lots of different personalities."

Schell's work in station procurement and contracts is also complicated by the fact that, for the past two years, NASA has been working to revise program contracts. Why now? Shuttle retirement creates an opportunity to look for more efficient ways to do business.

"Normally, just recompeting a contract is a lengthy process on its own," Schell explained. "But when you go through a change in requirements so major — that's a whole new business field."

In the longer term, the Commercial Resupply Services contracts awarded in December 2008 to Space Exploration Technologies Corporation and Orbital Sciences Corporation for upmass and downmass services to the space station will be the future, post-space shuttle.

Challenges, Challenges and More Challenges

But in the short term, building all those spares is a technical challenge. And it's an even bigger program and resource management challenge.

"We had to free up the resources and skills needed to get back into the business of building the orbital replacement units, or ORUs," Elsner explained. "Now most of these ORUs are what we call 'build to print,' but in some cases we've identified the opportunity to redesign to be more efficient. If we can launch one component instead of two, that's a good thing."

"If we can launch one component instead of two, that's a good thing."

But to do that, the vehicle office team and the people who understand the technical details of the ORUs had to lead the way. The redesign proposals had to be reviewed to understand such issues as where would they need to use new piece parts because the old ones are obsolete. Then the procurement staff had to submit requests for proposals, evaluate the proposals, conduct additional fact-finding and negotiation ... it's a huge workload.

"We've had to rely on a team that was already fully subscribed," Elsner noted.

Asking the Crew, and the Station, to Do More

The repairs-to-spares shift also shed a cold light on diagnostics. If broken equipment was no longer returned to Earth for cause of failure evaluation, how could the program assure that the same failure wouldn't occur again on equipment already inventoried on station? The program will have to rely on its eyes and ears in space.

"What this means in the long run is that we'll be asking the crew to do more."

"What this means in the long run is that we'll be asking the crew to do more," Mike Raftery, Boeing's deputy program manager for station, explained. "After retirement of shuttle, the crew will need to take on additional responsibility for diagnostics."



Astronauts conduct a spacewalk at the space station during STS-119.

The crew will need to determine what failed and why. Of course, their ability to do this will be limited by the tools they have on board, the focus and depth of their training, and the ability of teams on the ground to uplink procedures to them so they can perform the diagnostics and some repairs without having to discard failed items and then wait for the next delivery.

"We'll become much more reliant on data," Raftery said. "We'll be asking the crew to take pictures and send them to the ground. It'll take a lot of back and forth communication to figure out what's wrong and assess the diagnostics."

But diagnostics are only the beginning. Since the hardware won't be returned for repair, replacements have to be available and some pre-deployed on station. Then there's the challenge of developing new software and implementing needed upgrades. That is to say, can new software be written and implemented to deliver new functionality to the station's existing equipment?

New Software for the Hardware Aloft

As lead for sustaining engineering for station, one of Boeing's responsibilities is to evaluate all the station's systems to make sure they're healthy and there are plans in place to keep them healthy.

"Software is really our last degree of freedom," Raftery said. "Once the hardware gets locked down, you can't change that anymore. But you can change the software. You can develop new software as a way to get the hardware to do something it hasn't done before."

Obviously this is a big job, because the station's software is the lifeblood of the entire orbiting system. But it's also an area that's rarely noticed, much less discussed, in the outside world.

"When you start talking about station flight software, folks just seem to nod off," Raftery added. "It's a tribute to our team that software is not a problem today. Most programs as complicated as ISS have huge issues with software."



Astronaut Michael Fincke, Expedition 18 commander, takes a spacewalk to take care of some maintenance chores on the station.

The station program also had to develop new ways of doing some very basic things.

"There are a variety of services and capabilities that are provided by shuttle when it is docked at the station, such as nitrogen and oxygen resupply," Elsner explained. "So do we carry nitrogen and oxygen up to station in heavy, high-pressure bottles on commercial resupply services vehicles, which would be very expensive? Or do we develop a new system to convert the low pressure gas to the high pressure we need?"

And that's just one of many needs that are being addressed. Even the station's spacesuits are now affected because they need to be certified for longer periods of time.

New software, new processes for fundamental activities, retooled logistics and maintenance philosophy — there doesn't seem to be much in the way of station operations that isn't impacted by the space shuttle's pending retirement.

Costing More to Do the Same

All of the above adds up to a lot more work in a very short time frame. And once the shuttle ceases to be an integral partner for the space station program, station will cost more, too.

"We used to share a number of costs with shuttle such as Mission Control," Elsner said. "Shuttle had control rooms and we had control rooms, but we shared common power systems and common data systems. With shuttle gone, NASA won't need as much capacity in total, but ISS costs will go up."

"With shuttle gone, NASA won't need as much capacity in total, but ISS costs will go up."

Constellation could certainly start utilizing some services and facilities and share those costs with station, but they likely won't be in a position to start picking up those costs until well after shuttle has retired.

Crew transportation is also a cost issue with shuttle retirement.

"With the Russians, we've had a long history of success transporting crews," Elsner said. "So we're already buying Soyuz services. And you have to have a lifeboat to bring them home in an emergency situation."

The shuttle, as versatile as it is, could never provide the latter. So working with the Russians on crew transportation has never been an either/or proposition.

"We've always had to partner with the Russians to buy Soyuz services," he said. "And with the shuttle gone, we'll need to buy more of their services for a longer time."

18 Months to the Finish Line

With eight shuttle missions left to complete station assembly, there's still much to do to make sure station won't miss a step post-shuttle. Fortunately, station won't lose all the services of the shuttle workforce.

"Station will take over some of shuttle's property, like flight crew equipment and other piece parts," Elsner said. "And the shuttle workforce, with their skills and resources and energies, will have opportunities to help keep ISS going and fully utilized."

So once the shuttle fleet has officially retired, there will still be an indelible shuttle legacy deep within station.

After all, without the services of the space shuttle over the past decade, the International Space Station could never have spread its solar wings and flown.



Powered up for six crew, the space station viewed as Discovery undocked.

Filling the Gap: After Shuttle Retirement, There's CRS

What became the Commercial Resupply Services, or CRS contract, for the space station got its start back in the fall of 2006. That was when station leadership began working with Space Act partners to define the processes needed to develop commercial requirements for a post-shuttle transportation system for cargo. The objective was to develop a pool of potential providers. By mid 2007, the ISS program had put together a commercial procurement strategy intended to stimulate non-traditional or new contractors, in addition to major, long-term space program players.



SpaceX's Dragon spacecraft is recoverable and has a flexible cargo and crew configuration.

In late summer 2007, the agency released a request for information that asked industry to comment on certain terms and conditions. Industry responded with data on lead time requirements for commercial missions, what kind of specific terms and conditions would be desirable, as well as other contract criteria. In the fall of 2008, the station; the Kennedy Space Center Launch Services Program; the Commercial, Crew and Cargo Program Office, known as C3PO; the Space Operations Mission Directorate; and the Exploration Systems Mission Directorate conducted a day of one-on-one interviews with industry representatives to gain further insight. The draft request for proposals was issued in March 2008 and the official request for proposals for commercial resupply services for the space station was issued in mid-April 2008. Two CRS contracts were awarded on December 23, 2008: to Space Exploration Technologies Corporation, or SpaceX, for 12 missions; and to Orbital Sciences Corporation for eight missions.

Kathy Lueders, transportation integration manager for the International Space Station Program, talked about the timing of the program and how CRS differs from prior spaceflight contracts.

"Our goal was to have flights to station starting in December 2010," she said. "We understand the risk of developing two new vehicles, but our task was to procure the upmass to perform logistics

and utilization that the shuttle provided. In effect, the fleet will be brand new with ATV, HTV and the CRS vehicles."

Post shuttle, at the front end the station will be more heavily dependent on HTV and ATV missions, Lueders explained. At the back end, however, it will be much more dependent on CRS: In the 2010-2011 timeframe, about 40 percent of the upmass will come from CRS, increasing to approximately 70 percent by the 2014-2015 timeframe.

The challenge this presents to the station workforce is that these new CRS vehicles will be integrated in less than half the time they had for ATV and HTV integration.

"In two and a half years, we'll have done for SpaceX what it took us more than seven years to do for HTV," she emphasized.

Although the integration schedule is compressed, the ISS team is smarter about how they're getting things done. For example, instead of creating a set of requirements for integrating with station for each vehicle, they imposed a set of minimum requirements for commercial resupply services providers. This,



An artist's rendering of Orbital's pressurized cargo module approaching the International Space Station.

in turn, allowed them maximum flexibility in their designs. According to Lueders, they wouldn't have known how to define that minimum set if they hadn't applied the lessons learned from the ATV and HTV work.

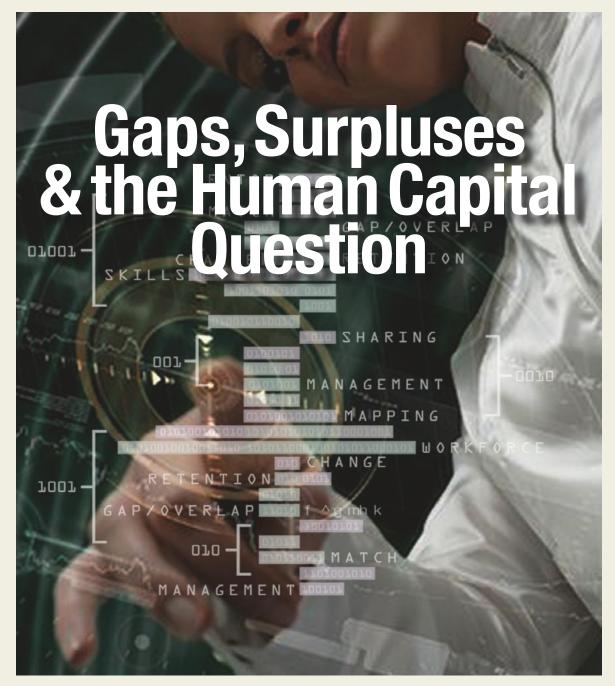
Although the integration schedule is compressed, the ISS team is smarter about how they're getting things done

Another key difference was shifting from a cost-plus contract environment to fixed price.

"We've typically had cost-plus development and sustaining contracts," Lueders said. "A fixed-price contract has limited interfaces and a defined set of requirements. For us, that meant making sure that we have the right set of requirements, because not only are they binding for the contractor, but they're binding for us, too."

According to Lueders, the whole point of having a fixed-price contract is that it allows the commercial provider to own their intellectual property and technological innovations, thus allowing a faster transition of the capability or innovation into industry for the greater good, instead of NASA retaining it in some dusty depot. That's a benefit that often is lost in the discussion of shuttle transition and retirement impacts on the International Space Station.

Think spin-offs.



When we first learned the closeout schedule for the Space Shuttle Program, 2010 seemed far away. Many of us thought there would be plenty of time to plan for the retirement of shuttle and the transition of its workforce. As we learned more about the Constellation Program, what its launch and crew vehicles would look like, the schedule for their design, development and testing, 2010 was still over the horizon. The workforce had plenty of questions about life after shuttle, but it wasn't an immediate concern.

Now, however, 2010 is fast approaching.

Rendezvous talked with many of the people tasked with figuring out the agency's human capital puzzle at Johnson Space Center, Stennis Space Center, Kennedy Space Center and Marshall Space Flight Center. And to get the other side of the story, we also talked with the program's major contractors — specifically Pratt & Whitney Rocketdyne, Lockheed Martin, Boeing Space Shuttle Program, Alliant Techsystems and United Space Alliance — about what life after shuttle will mean for them.

JSC: In-depth Assessment and Hands-on Assistance

MSFC: Working for a Seamless Transition SSC: Counting on Commercial Contracts

KSC: Mapping Skills to Constellation

United Space Alliance: A Different Kind of Challenge

Boeing: Retaining Critical Skills

Lockheed Martin: Preparing for the Next Phase Pratt & Whitney Rocketdyne: Propelled into the Future Alliant Techsystems: Taking the Long-Range View

It's been a long road to 2009 for the contractor and civil service team that's been working on the human capital puzzle for more than four years, and the year and a half left in the life of the shuttle program promises to fly by.

It began with a series of surveys designed to find out what people were most concerned about and what they thought they might do after 2010. Then it moved into workforce mapping at the macro level, trying to get a clearer picture of what the shuttle workforce would look like in 2010 and how that would match up with Constellation's needs. Now they're getting down into the nitty-gritty details that everyone's been waiting to hear.

"We've been operating at the big picture level, and now, as a community, we're starting to drill down to the unit and employee level," said Sue Leibert, human capital lead for the Space Shuttle Program. "From the macro to the micro level."

By necessity, Leibert said, they had to start big. They had to figure out the flows and the patterns. Johnson Space Center, an operations center, will be affected differently by the shuttle's retirement than Marshall Space Flight Center, where hardware is built. And transition is different for Boeing or Lockheed Martin than it is for United Space Alliance, for example.

Plus there was some uncertainty thrown into the mix. The timing of transition has spread out as technical decisions, budget and politics came into play, changing the situation that Leibert and her team were dealing with. Even now, the agency is anticipating the results of the 90-day review of the human spaceflight program, announced with the May 2009 release of the 2010 NASA budget, to find out what the future might hold.

"People are asking where they fit into this thing."

But somehow, Leibert said, each organization has crafted a plan that not only is flexible enough to deal with future changes, but is also just about ready to start answering the question individual employees have been asking all along: What's going to happen to me?

"People are asking where they fit into this thing," she said. "All of the organizations, all the centers and our contractors are doing some sort of workforce mapping, or getting ready to, at the employee level."

It requires more of a one-on-one approach in which individuals are given the opportunity to express where they might like to go and what they might like to do. They are asked: Are they thinking about a career change? And what will they need to help prepare themselves to move on?

JSC: In-depth Assessments and Hands-on Assistance

As the current lead for human capital transition at Johnson Space Center, Sylvia Krzmarzick knows that life for the shuttle workforce is just not going to be the same. Shuttle people care deeply about the program, likening its retirement to the disbanding of a family. All the more reason, then, to make sure that every shuttle employee is given an opportunity to shape his or her post-shuttle career.

With that in mind, she, along with Paul Cruz, human resources development representative for the Space Shuttle Program Office, and a team of human resources professionals, have worked tirelessly to help create the strategies, tools and tactics needed to support the shuttle workforce as they 'transition' out of the shuttle program. Cruz, for instance, has been holding retreats in which workers are led through exercises to help them think about their current positions and how their experience might translate into future positions on another program.



Johnson Space Center in Houston, Texas.

"We talk about the characteristics of a potential job on a slightly more abstract level," Cruz said. "We ask 'what kind of job do you want?' As we move forward and get more of a handle on what the actual jobs will be, then we can map those desires to actual positions."

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To help plot the course, the team uses the Career Pathfinder tool, which Krzmarzick described as a kind of human resource spreadsheet. It captures what the individual employee is currently engaged in as well as his or her forecasted level of effort required through 2010, broken down into quarters. It also captures the highlights of an employee's work, and lists three to five divisions at JSC that specifically interest them, in terms of the future of their career.

In addition to working transition issues on an individual level, Krzmarzick and Cruz are also involved with integration and coordination of center activities. They, along with the human resources leadership team, have been working to determine the key success factors for transition. They've developed plans to meet those key success factors including: actual transition from one role to another; communicating about workforce issues; and training and development. And they're asking questions such as what should the center look like post-shuttle, so that they can make sure all their activities in the next 18 months will feed into and meet those goals.

Communication is key. Krzmarzick and the others are also currently working on a team to develop an employee-focused Web site to help people look for job opportunities, upload résumés and browse for transition-related event schedules.

But it's about more than just "transition." It's about re-framing how to think of the challenges ahead and helping the workforce evolve into what they need to become.



Marshall Space Flight Center in Huntsville, Alabama.

MSFC: Working for a Seamless Transition

Transition is no less of a challenge at Marshall Space Flight Center. The center's managers have already conducted career discussions with their people to determine what they'd like to do in the future, when they'd be available for new work and whether they might be open to "matrixing" — or cross-assignments — in order to get their feet wet in some program or project areas beyond shuttle. And DeAdrian Maddox, team lead for the Office of Human Capital Shuttle Transition, is busy making sure that the shift from one program to another is as seamless as possible for the center's civil servants.

But instead of creating new tools and services, she and her team decided to leverage existing opportunities and focus on four key areas — skills retention, change management, career development and communication.

In the area of skills and workforce retention, the OHC Shuttle Transition team conducted their own survey with civil servants early last summer to get a picture of what the 'foundation of retention' looked like for Marshall.

"We had 74 percent participation out of all our civil servants and of that, 88 percent indicated that they'd like to stay through the end of the shuttle program," Maddox related. "So in regards to retention our status is green."

But the change management piece of the pie was a little trickier.

"We started with awareness messages about why we're going through this change," Maddox explained. "These messages were posted on the Web site and reiterated in staff meetings. Then we provided shuttle managers with specific change management training followed by Employee Assistance Program 'lunch 'n learns' on how to manage stress with the tools and mechanisms for dealing with transition."

Then there's career development. The Marshall Employees' Center Overview program, facilitated by senior Human Capital Consultant Gregory J. Walker, includes employee orientation on Marshall and the Redstone Arsenal in terms of businesses, organizations, governance, performance institutions, as well as processes and procedures. Offered to groups of 40 employees at a time, the Center Overview program covers the human capital offerings that many individuals have not had the opportunity to use, or been made aware of, thus far.

"We're educating them on everything the center has to offer and the tools they'll need to facilitate job searches, transfers and reassignments."

"We're educating them on everything the center has to offer and the tools they'll need to facilitate job searches, transfers and reassignments," Maddox said. "So they'll feel that they have some input into where and how they're moving into the new Constellation environment."

In effect, the Center Overview is providing Marshall's shuttle workforce with the foundation they need to move forward.

Communication is listed as a separate initiative but clearly plays a vital role in each of the key areas of focus. Maddox herself attends shuttle management meetings, acting as the ears for the workforce, listening for key points that managers need to be sure to pass on to their employees.

She also puts together the Office of Human Capital Web site's transition message and a biweekly transition tip that's e-mailed out. She tries to cover all the bases of what transition means to people by focusing on three distinct areas: technical, informational and personal, or T.I.P. Technical communication focuses on technical and engineering issues. Informational communication deals with human capital issues and change management. And personal communication, which is managed and written by their employee assistance coordinator, addresses coping, stress relief and strategies for staying healthy during uncertain times.

"We know from previous surveys that our workforce feels they need more communication about transition and retirement and the options available to them," Maddox said. "We are encouraged that, according to the most recent survey, our scores in communication are increasing."

SSC: Working to Fill the Gap

As a NASA center dedicated to supporting test activities that includes the space shuttle main engines as well as the J-2X engines destined for the Constellation Program, Stennis Space Center is facing a gap between the programs. According to Dorsie Jones, manager of the Office of Human Capital at the center, they're less concerned about the civil service side of transition and retirement than they are with the contractor side. That's who will be most impacted by the coming transition gap between programs.

"Our primary concern is with our contractor workforce, and that's contingent on budget issues," Jones explained. "As the budgets and schedules move out, we're concerned that if we don't bridge that gap, we'll be looking at layoffs for some of the contractors."

But there are several things being done at the agency, program and center levels to mitigate these potential contractor workforce impacts. Stennis is working with the contractors to identify solutions that will address attrition, company synergies and resource sharing across NASA customer sites. In addition to working with the contractor community, the center has continuing commercial work that will help fill the gap."



Seen from the air, the A-1, A-2 and B test stands at Stennis Space Center were initially built in the early 1960's to test the Apollo Program's Saturn V rocket. The A-1 stand in the foreground is being modified to test the J-2X engines for the Constellation Program.



Stennis' A-2 test stand in action on March 30, 2009, as a space shuttle main engine is put through its paces.

"We have to make sure that we have funding as it affects our contractors," she explained. "Because with the budget and schedule slippage, it could impact as many as 50 or 60 of our contractors."

That may not sound like a large group for a big center, but for Stennis, it's a significant portion of a very specific and highly skilled workforce. The problem is if the center loses those skills through unavoidable contractor layoffs, trying to replace that skill set or hire them back will prove to be extremely difficult. In fact, there's a two-year training period requirement to do what Stennis does.

Added to that very real concern is the fact that Stennis is a close community of talented and committed people who have spent most of their professional lives working on one phase or another of the space program. Everyone at Stennis is "family" regardless of who signs their paychecks — a relationship that is shared across most other NASA centers and facilities.

KSC: Mapping Skills to Constellation

Kennedy Space Center's map to the future is already beginning to take shape.

The center's civil service shuttle workforce has been captured by skill, category and level of support for the shuttle program. Now in Phase III, Juan Calero, acting lead for the Workforce Management Group, and Mike Van Houten, technical lead for the Human Resource Information Systems Group, are adding the International Space Station workforce's information into their human capital database. They're matching that combined workforce to Constellation demand to see how everyone will eventually fit into the program, by identifying gaps and surpluses in the skill sets, and which skills may be affected by new programmatic demands.

In addition to identifying skill gaps and surpluses, the mapping exercise was also used as an indicator for Available for New Work (AFNW).

"What 'available for new work' really means is that we have more resources in our workforce than we have requirements for in the 2011 timeframe," Calero explained. "Constellation won't ramp up quick enough to pick up that workforce."



The Vehicle Assembly Building at Kennedy Space Center in Cape Canaveral, Florida, with a launch pad visible in the distance

Fortunately, as requirements have become clearer, the demand for specific skills have increased somewhat, so the AFNW workforce is shrinking. Still, 2011 will be a pivotal year, in which Kennedy may experience a surplus in talent and capability. So NASA Headquarters, in coordination with the programs and Kennedy, are currently strategizing to determine how best to utilize Kennedy's possible available manpower with respect to skill sets.

Fortunately, as requirements have become clearer, the demand for specific skills have increased ...

For example, to address the increased demand they're seeing in systems engineering and the surpluses they'll experience in integration engineering before they launch hardware in 2015, Calero and his group are trying to identify which engineering skills can map over to the other engineering discipline. He explained that this mapping is really focused on identifying how much of their workforce can be retrained and retained.

To help facilitate the transition process at Kennedy, Calero and Van Houten and their teams have developed several tools designed to help shuttle employees identify opportunities and take control of their futures.

The Human Resources Workforce Tool (HRWT), for instance, allows employees to enter skills and historical work information so supervisors can cross-match abilities to future work and, in effect, define the supply. Combined with a tool that engineering uses to map budgets and determine work demand, they can identify skill gaps in the supply and demand scenario for the center. The Employee Development Opportunity Tool (e-DOT) helps employees find and take advantage of the additional training they may need to qualify for future work. And the Mentor Match tool helps employees seek mentoring relationships with senior members of the workforce.

"These are all just being used at Kennedy right now," Van Houten explained. "But we've demonstrated them agency-wide. We've received a fair amount of interest in our Mentor Match tool, and Johnson is interested in e-DOT and the HRWT."

Concerned About the Contractors

The shuttle program's human resources and transition management teams at Johnson, Marshall, Stennis and Kennedy, all feel fairly certain that the civil service workforce will come out all right in the long-term. But all four centers are concerned about what will happen to the program's contractor workforce during the gap between shuttle retirement and the onset of a regular launch schedule for Constellation.

Life after shuttle will be completely different for them.

All shuttle program contractors will be affected, of course. We couldn't talk to them all, but together, Boeing (shuttle engineering and integration), United Space Alliance (shuttle ground and flight operations), Pratt & Whitney Rocketdyne (shuttle main engines), Alliant Techsystems (solid rocket boosters) and Lockheed Martin (shuttle external tank) account for a shuttle workforce that numbers well over 10,000. Life after shuttle will be completely different for them.

United Space Alliance: A Different Kind of Challenge

Transition at United Space Alliance, or USA, is different than the transition that civil servants are facing.

As contracts change from operations to design, development, testing, evaluation, manufacturing and delivery of new systems, a substantial drop in workforce requirements will be experienced in launch and recovery systems and all of the support systems that go into flying the shuttle. Howard DeCastro, vice president of USA's space shuttle program, pointed out that, according to the plan, the Constellation Program will be less workforce-intensive and, therefore, more cost efficient.



Of course, some of the workforce will hopefully have an opportunity to transition to new contracts the company is actively pursuing, or be able to migrate to another program with another contractor. But the reality is their workforce of approximately 9,500 will drop by about half after the shuttle retires.

"We've been open and forthright about what we understand our future to be and how we're preparing for it," DeCastro said. "We've communicated with our workforce through our leadership, through face-to-face meetings and through meetings where we've brought about 700 of our key managers into half-day sessions. We've assembled an extremely aggressive new business team to pursue contracts."

DeCastro explained that United Space Alliance's broad strategy is to win as much NASA and Department of Defense business as possible and to become more center-centric – in other words, concentrate more on each agency center as a direct contractor.

In regards to holding on to the critical skills needed for the remainder of the shuttle's manifest, DeCastro described incentivizing the workforce along the same lines and with terms similar to those of Boeing and Lockheed Martin.

"We recognize that we won't have a job for everyone, but we have identified more than 6,000 individuals as having critical essential skills."

"We recognize that we won't have a job for everyone, but we have identified more than 6,000 individuals as having critical essential skills," DeCastro said. "And we're in direct communication with every employee to understand what keeps them here and what their needs are so we can make sure we're treating them as well as we can within our salary, bonus and separation policy limitations."

DeCastro emphasized that the company was doing everything possible to mitigate the impact of shuttle retirement on its workforce: aggressively pursuing new contracts, providing cross-training opportunities where appropriate, and communicating and listening to their employees as well as their NASA customer.

"We're telling our people what we know, when we know it, so they don't have to read the paper to know what's going on with our company," he said. "And we'll continue to do that, good or bad news. We'll work together to do the best we can for our workforce."

DeCastro is convinced that the USA workforce will finish the shuttle program and walk away with their heads held high, saying, "We did it."

Boeing: Retaining Critical Skills

John Mulholland, vice president and program manager for Boeing's Space Shuttle Program, explained the transition and retirement challenges facing Boeing's dedicated workforce and emphasized the necessity of retaining the critical skills required to fly the shuttle safely while preparing for the future.



"The tough challenge we face is convincing a team of highly talented individuals to stay on a program that's nearing completion," Mulholland stated. "And the only way to make folks comfortable with the situation is to prove that you're doing everything in your power to make sure they'll have real opportunities when the shuttle program is over, and that you'll help them be ready when the time comes."

"The tough challenge we face is convincing a team of highly talented individuals to stay on a program that's nearing completion."

Similar to the surveys conducted at NASA, Boeing Space Exploration conducted a workforce transition survey that delved into their employees' future plans post-shuttle. Within the company's shuttle workforce, they leveraged the findings from the survey with "stay interviews" between managers and their employees. This helped them better understand what motivated their employees to stay committed to shuttle through its final missions and how to better prepare them for the future. It also helped them develop specific human capital initiatives to address their transition and retirement challenges. And like their NASA customer, they mapped their workforce based on skill code and criticality.

Boeing's Space Shuttle Program Retention Plan includes two initiatives that are unique to their shuttle program: the SSP Incentive Plan and the 3Cs. The incentive plan targets those who fall into Boeing's critical skills categories. The 3Cs initiative is aimed at all of Boeing's shuttle employees and focuses on areas of competency, capacity and commitment to encourage skill development, promote acceptance of new challenges and support open and honest two-way communication.

Mulholland is encouraged by the opportunities he sees downstream. He believes that Boeing's skill set maps into future Constellation work – particularly Ares I – as well as other Boeing programs.

"Boeing has an extremely diverse set of programs in our portfolio that include commercial and military aerospace, in addition to our work in human spaceflight and space exploration," he said. "We've worked hard to outline our future skill set needs and to identify opportunities for employees interested in further development."



Viewed from the air, the Michoud Assembly Facility in New Orleans is the home of NASA's external tank program.

Lockheed Martin: Preparing for the Next Phase

The Michoud Assembly Facility in New Orleans is a community unto itself. The retirement of the shuttle and the delivery of the last external tank to the Cape spells the break up of a dedicated workforce that has overcome a number of hurdles over the years, including lengthy stand downs and devastating hurricanes. And now Lockheed Martin's external tank family is facing its largest challenge yet.

Twanda Vaughn, human resources business partner in Lockheed Martin's external tank program, ties the size of the workforce's transition and retirement challenge to the longevity of the shuttle program. Many people have spent their entire careers working on the shuttle's external tanks and now, for the first time in their lives, they need to prepare for the next phase of their working life — possibly in another location.

"Preparing for transition involves a lot of big decisions that are already affecting individuals

and their families," Vaughn stated. "It requires that they do things they haven't had to do for more than 20 years."

For instance, refreshing their job searching skills, including writing résumés, interviewing and networking, not to mention some pretty deep soul searching. Vaughn explained that for many Lockheed Martin employees at Michoud, new jobs could also mean possible relocation and uprooting their families. But for many, there is also the consideration of retirement.

After three rounds of RIFs, or reductions in force, some of the natural resistance to change and the underlying sense of hope that the shuttle program would be extended is waning. Vaughn explained that following up with people who have successfully moved on or transferred to a different Lockheed Martin location after they'd reached the end of their assignment on the program — in other words, presenting "life after external tank" experies



assignment on the program – in other words, presenting "life after external tank" experiences – has helped the situation become more real and more immediate for many at Michoud.

One-on-one dialogues between individuals and leadership have focused on post-shuttle career planning. Mostly a career-mapping exercise, these sessions are helping Lockheed Martin employees chart out their career options by determining their plans and their willingness to relocate, if necessary. Vaughn explained that this is an ongoing process because as end-dates get closer and opportunities for continuing employment at Michoud lessen, minds begin to change and plans become more fluid.

... as end-dates get closer and opportunities for continuing employment at Michoud lessen, minds begin to change and plans become more fluid.

"What we've done is say, okay, this is what you've said you want to do," Vaughn related. "Then we ask, is that still the case?"

In effect, they're rechecking individuals' status in order to determine how to best support them through the transition, with after-hours training programs and education or job fairs conducted in partnership with the Louisiana Workforce Commission and participating colleges and universities.

In addition to career mapping, Lockheed Martin has also conducted extensive critical skills mapping to identify those skills required for flying out the shuttle, the skills required for the Constellation Program and to match skills that may be required in some other part of the corporation.

Vaughn elaborated that they have a transition strategy team in place that's aimed at job placement opportunities within Lockheed Martin. The team consists of staffing specialists, hiring managers and key leaders from across the corporation who are focusing on retaining the company's highly skilled workforce.

Despite not having a clear picture on exactly what skills Lockheed Martin employees at Michoud have that Constellation will need, critical skills retention is the initiative they have in common with the rest of the shuttle program contractors.

"If we could keep all of our skills and apply them to Constellation, that would be what we'd like to do," said Vaughn. "The problem is the gap between the programs."



Pratt & Whitney Rocketdyne Division in Canoga Park, California.

Pratt & Whitney Rocketdyne: Propelled into the Future

The extended space shuttle main engine (SSME) family at Pratt & Whitney Rocketdyne (PWR) is in the same boat as the other contractors. Their biggest challenge, according to Brent Milburn, director for PWR's business operations for the space shuttle main engine, is to keep their workforce focused on flight safety despite the looming end to their program.

"We're going to transition a significant percentage of our SSME workforce over the next 17 months — obviously job retention in the future is a huge concern," Milburn said. "Add to that the impact to all other aspects of their lives from the reductions in workforce caused by the downturn in the national and global economies. With all of that swirling around, keeping the SSME workforce focused on flight safety is key."

Pratt & Whitney Rocketdyne is handling the angst in the workforce in much the same

manner as Boeing, Lockheed Martin and United Space Alliance. They've conducted surveys and held focus groups at all five of their sites across the country to get a bead on what their folks are thinking and what they're worried about.

The No.1 issue for employees and managers alike was the uncertainty of the future.

The results were hardly surprising. The No. 1 issue for employees and managers alike was the uncertainty of the future. To address this, along with other issues that bubbled to the surface, PWR adopted a phased approach and implemented a series of human capital initiatives. Their goal was to retain employees, map their skills to current and future work, determine the best options available for meaningful employment with the company and provide the training necessary for that employment. A career development Web site was built to provide a place to post job sharing and transfer opportunities. Another was developed for the posting of short-term task needs that could provide employees a chance to sample other work areas. Finally, to make sure they have the right skills in place all the way through to the end of the shuttle program, PWR built an extensive database to keep track of all its employees who charge to the space shuttle main engine project.

"We identified a primary and secondary ready-now backup for each employee," Milburn said. "If we find that we have an employee who is not interested in staying to the end of the shuttle program, the first thing we do is check the database for a backup. And if we don't have a ready-now backup, then we identify steps to ensure that our skill sets are, at the least, one deep — two deep with the backup."



There's not much difference between NASA's workforce mapping exercises and PWR's skills database – both work to identify gaps and surpluses. But in PWR's case, they prefer to describe it in terms of preserving their bench strength within their four walls – or five sites.

"We've been working a broad spectrum in terms of techniques and ideas to keep our employees engaged," Milburn explained. "We want them to know that we're concerned about their future and that we're actively looking for opportunities to move the right people at the right time to other programs."

Alliant Techsystems: Taking the Long-Range View

There are a couple of basic differences between Alliant Techsystems' (ATK) future landscape and that of the other shuttle prime contractors, according to Glen Curtis, reusable solid rocket motor transition manager for ATK. For one, the facility near Brigham City, Utah, where most of their shuttle work is performed, is not government-owned although the shuttle's solid rocket motors are their single most significant activity. But there are other activities that require the attention of a multi-program workforce. In fact,



about half of the ATK team members who work on shuttle spend less than 50 percent of their time on it. Of course, it doesn't hurt that ATK is also working aggressively on the Ares I first stage program.

"We have a larger role in that program, which represents the future," Curtis said. "We have some continuation with heritage elements — the people and the production processes — that allow us to take a long-term perspective, both as a company and for individuals who are invested in the space program within the company."

"We have some continuation with heritage elements

- the people and the production processes that allow us to take a long-term perspective ..."

That's not to say that ATK doesn't have its share of challenges. Like other shuttle contractors, maintaining a strong team-wide focus, from the work floor to engineering to management, assuring safe flight is paramount. At ATK, this means making sure that all of their processes are consistent and intact. Curtis feels that the company's continuous improvement initiatives implemented over the last several years have helped them deliver on that promise. Plus, they've invested considerable effort in the improvement of leadership to evolve into a better company. These efforts include training programs to help them communicate better, relate better and support their teams fully.

"This kind of activity is critical in any time of crisis," Curtis said. "Whether it's an economic crisis or because of a program change such as the one we're facing today, people depend on their leadership to be honest with them and help them understand what they can do. People who are fully informed about the coming change can better focus on their remaining responsibility to make sure that the last shuttle mission is a safe one."

"People who are fully informed about the coming change can better focuse on their remaining responsibility to make sure that the last shuttle mission is a safe one." As for workforce mapping, it takes on a different meaning at ATK. Curtis explained that it's not a matter of trying to find a good fit for skills as shuttle retires and Ares I takes off. The existing skills are required for both programs. The challenge is protecting the shuttle workforce while simultaneously developing and building initial Ares I boosters. In the touch functions as well as most support organizations, ATK uses the same people to work both programs. Design engineering and program offices have parallel but closely coordinated teams that will merge after shuttle retirement to support the continuing effort.

Since not as many people will be needed for Ares I, ATK is aggressively seeking additional opportunities to support NASA and other customers that would help protect the company's skills and keep them in place. For those who won't be needed for the ongoing program, ATK provides professional placement services and severance to help them find opportunities to move forward and find meaningful work.

"Our challenges are different [from that of other shuttle contractors] because we have an ongoing program," Curtis stated.

But in the end, they share a common responsibility.

"We need to make sure we finish the job and do it right," Curtis concluded.

Meaningful Progress

The agency's space shuttle human resources and transition teams are all equally concerned about what's happening on the contractor side of the fence the closer we get to 2010. And Leibert believes the concern has translated into meaningful progress on preparing for the shuttle's retirement.

"Each one is different, and therefore each project has developed a plan that makes sense for their contractors ..."

"Each one is different, and therefore each project has developed a plan that makes sense for their contractors, and each contractor has developed a plan that makes sense for their particular circumstances and their workforce," she said.

That doesn't mean the problem is completely solved. As Leibert explained, the risk that the questions of retention and critical skills pose to the program isn't going away just yet. But everyone — whether on the civil servant or contractor side — is working together to minimize it, protecting both the shuttle program and the workforce that keeps it flying.



Got a Light?

"3... 2... 1... Ignition!" isn't nearly as exciting without an igniter. That doesn't appear to be an issue for the Constellation program, though.

On March 10, NASA completed a test firing of the igniter that will be used to start the Ares I rocket first stage motor.

Conducted at Alliant Techsystems' launch systems' test facilities near Promontory, Utah, the test produced a flame almost 200 feet in length, and early data showed the igniter performed as expected.

Got a Light?

One for the Road

Review from the Top

If You Build it...

Orion Abort Flight Test Comes Together

Orion Makes a Splash

Heads Up

The Ares I igniter is an enhanced version of the flight-proven igniter used in the space shuttle's solid rocket boosters. Upgrades to the liner and insulation materials will protect the igniter's case from the burning solid propellant. The igniter, 18 inches in diameter and 36 inches long, is a high-burn-rate motor that, upon starting, will send a flame through the core of the 142-foot solid rocket booster. That, in turn, will produce 3.3 million pounds of thrust, launching future astronauts into orbit.

The successful test sets the stage for the first ground test of the Ares I first stage later this year.

One for the Road

The final pieces of the Ares I-X flight test rocket left the Alliant Techsystems, also known as ATK, manufacturing facility in Promontory, Utah, on March 12 and arrived at NASA's Kennedy Space Center in Florida on March 20 — a journey of 2,917 miles.

These last pieces of Ares I-X major hardware elements are now undergoing final processing and preparations before being stacked with the other sections of the rocket.

With all of the hardware in place, excitement is building for the first flight test later this year. The Ares I-X four-segment solid rocket motor is a fusion of existing shuttle and simulator hardware that will resemble the Ares I rocket in size, shape and weight. A fifth simulator segment will be added to more closely replicate the Ares I. The test will provide NASA its first opportunity to evaluate and prove hardware and analysis models, as well as new or modified facilities and ground operations associated with Ares I.



Final segments on track from Alliant Techsystems facility in Utah to NASA's railhead in Mims, Fla.

Review from the Top

In the midst of several landmark shuttle missions and a flurry of Constellation activity, two significant steps toward the future occurred in May. Concurrently, the Obama administration released the 2010 budget, allocating roughly \$18.7 billion to the agency, and announced a 90-day review of the human space flight program.

The review panel will be headed by Norm Augustine, a former Lockheed Martin chairman and CEO who has served on the President's Council of Advisors on Science and Technology, the National Academy of Engineering and the Aerospace Industries Association. Augustine will review the current plan for the future of human spaceflight and explore the possibility of viable alternatives. In a letter to Christopher Scolese, acting administrator for NASA, the director of the White House Office of Science and Technology, John Holdren, stated that, "Given the magnitude of America's human spaceflight ambitions ... and the significant investment of both funds and scientific capital ... it would be only prudent to review the array of challenges in the program and the options for addressing them."

The new budget represents a 5 percent increase for the agency, with \$150 million allocated for the Exploration Systems Mission Directorate ...

As the panel reviews the current direction of human spaceflight, Congress will be reviewing the President's proposed NASA budget for 2010. The new budget represents a 5 percent increase for the agency, with \$150 million allocated for the Exploration Systems Mission Directorate, which is responsible for development and production of Ares I and the Orion Crew Exploration Vehicle, two components of the Constellation Program that will be receiving a lot of attention from the President's review panel.

Even as the program is being reviewed, NASA plans to carry out all current Constellation activities through the 90-day study.

"We are going to continue to move ahead," said Scolese. "We're not stopping anything."

If You Build It...

With renovations completed on the Operations and Checkout Building - or O&C - high bay at Kennedy Space Center on Jan. 26, the Constellation Program put into place another important piece of the puzzle.

Representatives from NASA, Lockheed Martin, Space Florida and the state of Florida participated in a ceremony celebrating the completion of renovations to the historic building, which was originally built to process space vehicles in the Apollo era. As a part of the Constellation Program, the O&C will be the final assembly and checkout facility for the Orion crew exploration vehicles.

The renovations targeted virtually everything within the 70,000-square-foot high bay and the 20,000-square-foot basement, except the basic structure. Participants in the ceremony were given a tour of the facility, which revealed new walls, ceilings, paint, air conditioning, wiring, a new state-of-the-art heavy-lift crane and specially-designed epoxy flooring. Participants also were able to view mock-ups of the Orion capsule and its heat shield.

In addition to the significant step forward that the building represents for the Constellation Program, the facility is also expected to house approximately 400 workers.



The launch abort system pathfinder prepares to truck from NASA Langley in Hampton, Va, to White Sands Missile Range in New Mexico. The pathfinder will support the first flight test of the abort system, called Pad Abort I.

Orion Abort Flight Test Comes Together

NASA has completed work on a 92-acre launch complex at White Sands Test Facility near Las Cruces, N.M., that will serve as the test site for abort flight tests of the Orion crew exploration vehicle. Right on time, too. During the same week the launch abort system pathfinder left NASA's Langley Research Center in Hampton, Va., on its long cross-country road trip to the launch complex.

The launch complex will allow NASA to test the system, which will jettison the vehicle's crew to safety if there is an emergency on the launch pad or during the first minutes of flight.

The complex includes a launch pad, launch services pad, ground support equipment, office space and the Flight Integration and Test Facility, and is now ready for the first test, the Orion pad abort flight test — also known as Pad Abort I.

For Pad Abort I, the launch abort system abort motor will be fired, lifting the Orion crew module test article mounted beneath it to an altitude of approximately one mile. The

demonstrator used for the test is the same size, shape and weight of the spacecraft that will be used by the Constellation Program for future missions to the International Space Station and the moon.

White Sands Missile Range will provide support services for this effort, including logistics, infrastructure, with critical emphasis on data collection, operations and management for the test, as well as for all other launch events.

Two pad abort tests and two or three ascent abort tests are currently planned for the Orion launch abort system, with later tests to be determined based on the earlier testing results.



The Navy-built, 18,000-pound Orion mock-up at the Naval Surface Warfare Center's Carderock Division in West Bethesda, Md.

Orion Makes a Splash

This first quarter of 2009 found NASA, in collaboration with the Department of Defense, preparing for Orion crew module recovery procedures. The work started in March with a full-scale mockup of an 18,000-pound module at Naval Surface Warfare Center's Carderock Division in West Bethesda, Md. The first round of tests were conducted under controlled conditions in the facility's test pool before ocean testing began April 6 off the coast of NASA's Kennedy Space Center in Florida.

The Post-landing Orion Recovery Test, known as PORT, is a dual-goaled test seeking to identify types of conditions astronauts might expect after splash down, as well as what the

recovery team can expect outside of the capsule. With the data collected and experience garnered from testing, NASA will design equipment and procedures for recovery, and training for rescue and recovery crews.

Heads Up

NASA, along with other industry engineers, successfully completed the second drop test of a drogue parachute for the Ares I rocket on Feb. 28 at the Army's Yuma Proving Ground near Yuma, Ariz.

The Ares I first-stage motor is designed to be recovered and reused after each flight, making a soft landing after launch imperative. The first step in accomplishing that is the deployment of the drogue parachute, the first phase of the rocket's deceleration system. The drogue parachute is designed to slow the first-stage motor's descent and orient it before deployment of the three main chutes that will carry the motor to splashdown.

The seventh in an ongoing series of Ares I parachute recovery system tests, the event involved researchers dropping a 50,000-pound steel, missile-shaped test payload with the 68-foot-diameter drogue parachute from a U.S. Air Force C-17 aircraft flying at an altitude of 25,000 feet. The test was a success and represents another step forward for the Constellation Program.



The drogue chute in full deployment prior to pulling out the main parachute.



Now, five years after the announcement of the Vision for Space Exploration, the Constellation Program feels real. Although there's been plenty of design and prototype development activity on certain elements, such as Orion, Ares I (and I-X) and Altair, and the world has seen a public demonstration of the lunar rover in the inaugural parade, the real proof is in the testing. Various motors and engines have already been put through some of their paces at test facilities in Utah, California, Virginia and Florida. But this summer, the flight test of the Ares I-X will occur at Kennedy Space Center and the first Pad Abort test will be conducted at White Sands Missile Range. After that, Constellation won't just feel "real," it will feel "now."

To learn about the challenges on the program's near horizon, its upcoming milestones and obtain a five-year progress report on space exploration's next big step, *Rendezvous* sat down with Jeff Hanley, manager of the Constellation Program.

Jeff Hanley is busy. Very busy.

With four fledgling vehicles under his purview — not to mention the ground and mission operations that support them — his schedule is planned to the minute and sprawls into the next decade.

With six years left until they're scheduled to start ferrying astronauts to the International Space Station, Orion and Ares I are now in the detailed design and testing phases. The Ares I preliminary design review was completed last August, and Orion's preliminary design review is scheduled for this August. Ares I will have a delta design review later this year to address one aspect of its design that was identified in the earlier preliminary design review as forward work. Meanwhile, though their first planned uses are still about a decade away, Altair and Ares V are already into their conceptual design phases, in which early designs and trade studies and analyses are being conducted. In fact, both have already passed their mission concept reviews, a major developmental milestone.

And, as if that weren't enough, the lunar surface architecture trade studies and analyses are well underway. This conceptual analysis of the habitats, rovers, science facilities and all the other elements that will make life on the moon possible, will feed the mission concept review for lunar activities late next year.

"We have activity in every phase of the development life cycle."

"We have activity in every phase of the development life cycle," Hanley said. "We have hardware that's showing up at the Cape to be launched in the next few months and hardware that's showing up out in the desert for Pad Abort I. We have activity going on in the detailed design phase and activity going on in the conceptual design phase. And we're doing a significant amount of trade studies and analysis to plan the lunar surface architecture. The progress we're making has been substantial."

The hard proof, however, that Constellation is making headway will happen this fall with the first test of a launch vehicle, the Ares I-X, to be conducted at KSC in more than 28 years, and the Pad Abort test flight at White Sands Missile Range. With hardware already showing up in each location, both excitement and expectations are mounting. And that's what Hanley points to when others are consulting their crystal balls, hoping to divine what the new administration might have in store for NASA.

"Anything can happen – as far as what direction the nation's space policy takes, we'll all have to wait and see," he admitted. "But I will tell you that we're making considerable progress with real hardware that will produce a rocket on a launch pad this summer."

The Constellation Program is banking on the fact that a rocket - not to mention the money and effort that go into it - is a terrible thing to waste. As long as the program gets the resources it needs, Hanley said, he knows the Constellation program can get the job done.

"We've run into nothing that is insurmountable with respect to the technical challenges," he said. "The only thing that really keeps me up at night is will the money be there."

A Matter of Money

According to plan, the Constellation Program's budget will increase in 2011 when the shuttle retires and no longer needs as much of its share. In today's economic climate, there's no guarantee that the plan won't change. But if it does, Hanley believes it would be a result of fiscal restraint across the entire federal budget, as opposed to a reflection on the Constellation program.

"I expect - and this is supported by folks that know a lot more about this industry than I do - that human spaceflight will continue to enjoy about two-thirds of the NASA resources, roughly," Hanley said. "That's basically where we're at right now; that's where we've been for the last couple of decades."



Ares I-X hardware arrives at Kennedy Space Center for its flight test scheduled for later this year.



A large overhead crane lowers the Ares I-X service module to the service adapter. Other segments of the launch vehicle are visible around the bay including the simulator crew module (foreground).

That means that the Constellation program will cost a fraction of what Apollo spent getting to the moon, and they plan to do more with the money they do spend – they're not just going to the moon, they're staying there.

Thanks to the Shuttle Workforce

That's where the shuttle workforce comes in.

"The shuttle team is the team that will stand up and take us to the moon," Hanley said. "There is an incredible amount of work to be done, and our ability to get to the moon by 2020 will depend upon folks rolling off of shuttle and rolling onto Constellation."

"The shuttle team is the team that will stand up and take us to the moon."

In some ways that's already happening. Hanley is quick to point out that Constellation wouldn't be where it is today without the support and partnership of Space Shuttle Program Manager John Shannon and the shuttle workforce.

"John Shannon has been a great partner to Constellation," Hanley said. "He's actively helping with resources where those can be applied smartly. He's funded several initiatives in support of Constellation. And we work together very closely on the business side of things — on the transition of assets, planning what happens to all the shuttle infrastructure."

Part of that is allowing the shuttle workforce to help out Constellation where possible — splitting their time between shuttle and Constellation duties, and even processing and launching Ares I-X.

In return, Hanley's working hard to ensure that Constellation is ready to take on the shuttle workforce when the time comes. That's why the program is already focusing not just on the immediate Orion and Ares I needs, but also the Ares V and Altair needs that are still many years out.

"Some would say, 'Well why don't you just put the moon off and focus on Orion and Ares I?'" Hanley said. "But it's incredibly important that we get enough definition to what Altair and Ares V need to be and the lunar surface systems that come after that, so that this workforce has something to go to work on as shuttle retires. Just in Orion and Ares I, there's not enough buying power there to cover the workforce. There's just not."

A Couple of Tough Years Ahead

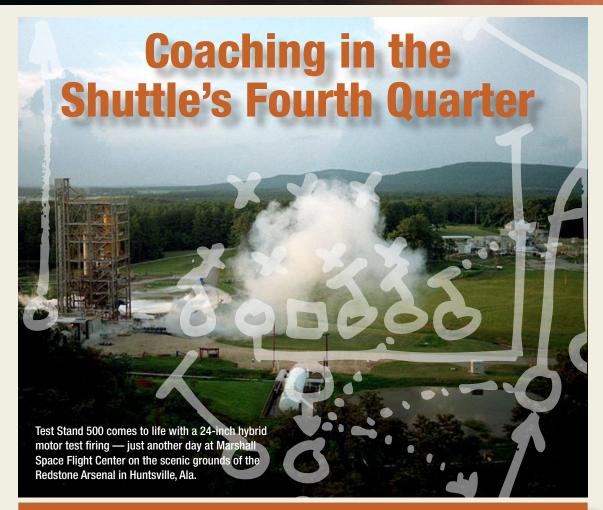
That means a careful balancing act for Constellation as it waits for the shuttle workforce and shuttle budget to become available, however.

"The 2009 and 2010 years are difficult funding years for our development program," Hanley said. "We have flat budgets in a development program that wants to ramp up to its peak at the critical design review stage. So we're doing the best we can to manage the risks involved in not having the money to do all that we would normally do if we had a more robust developmental program funding profile."

"Folks working on the space shuttle today are future lunar program contributors."

But he's doing his best to make sure the Constellation Program is ready for 2011, when it will get the dollars and the people it's been waiting for.

"Folks working on the space shuttle today are future lunar program contributors," Hanley said. "That's the way I would like to think they would start to look at it."

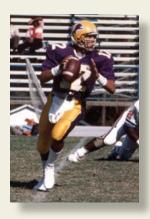


Tim Garner's calling some of the key plays in transition management at Marshall.



When Tim Garner, vice president of operations at DP Associates in Huntsville, Ala., talks about the support role he plays in Mike Allen's transition office at Marshall Space Flight Center, he uses a lot of sports analogies. Football analogies, to be precise. And to anyone familiar with Garner's long career with the shuttle program — or his background — that comes as absolutely no surprise. Cut Garner and he'll bleed purple and gold ... just like any former University of North Alabama Lions quarterback.

So it's also no surprise that Garner thinks of the remaining shuttle missions as the program's fourth quarter. It's a perspective he shares with veteran Crimson Tide linebacker Steve Cash, also known as the manager of the Shuttle Propulsion Office at Marshall, and United States Air Force Falcons' linebacker Mike Bloomfield, three-time shuttle astronaut and now vice president of Alliant Techsystem's Constellation Systems at Johnson Space Center. Last fall they were recruited to star in an intraagency video that likened the criticality of the remaining shuttle manifest to winning the game's fourth quarter. Finishing strong, so to speak, to carry that momentum into the next generation of space exploration.



An All-Pro Transition Team

"I've supported Mike Allen [space shuttle transition manager for Marshall] and his team since he took over the office," Garner said. "I've been providing liaison support between the shuttle program and Ares almost since the very beginning, so I've got a longer history with transition than many folks."

Garner explained that it was in 2007, during the Transition Program Requirements Control Board meeting, that funds were first requested to put together a transition team to handle all the program management tasks of transition — scheduling, risk management, metrics, etc. Since then, the scope of the transition office's responsibilities, not to mention the challenges, has grown significantly. The trick was, according to Garner, figuring out how to create an "all-pro" team that represented the interests of all the institution leads equally — in this case, the center and all the shuttle leads, including those in Marshall's extended contractor family.

The trick was ... figuring out how to create an 'all-pro' team that represented the interests of all the institution leads equally.

Garner's team handles the recordkeeping of all Marshall-operated transition activities, and that's a lot bigger job than it sounds. It includes everything from understanding exactly what is and what isn't an artifact and which particular artifacts the public would like to see preserved, to updating the metrics on property dispositioning and excessing.

In addition to that, they are keeping their eyes on a number of ongoing challenges. The environmental remediation of the shuttered Santa Susanna Field Laboratory's liquid-fueled components and propulsion systems test facility in California is one example. Assuring the uninterrupted production of external fuel tanks at Michoud Assembly Facility in New Orleans while the Ares team is moving in and claiming the real estate they need to set up production is yet another. So keeping a close watch on the Ares program's progress as it relates to the shuttle transition schedule is critical.

"We don't want to get rid of anything on the space shuttle main engine side that the J-2X people might need down the road," he explained.

... keeping a close watch on the Ares program's progress as it relates to the shuttle transition schedule is critical.

Shifting Cultures Ahead

Over the past year or so, Garner has noticed a shift in workforce culture at Marshall. In the shuttle world, the structure in place is rigid. Design changes have to be reviewed over and over again, signed off and vetted by multiple boards before changes of any kind can be implemented. In the Ares world, changes are not as difficult to realize.

"The difference is that we're building and processing and flying shuttles versus putting together design concepts, certifying them and moving into testing for Ares," Garner said.

And, as almost anyone in the extended human spaceflight community will admit, there are significant differences between operation and development cultures.

"The shuttle community is tight-knit, and you've got a lot of folks here at Marshall who want to stay with the shuttle to the very end because they have so much time and energy invested in the program," Garner explained. "So the shuttle way of doing things is totally ingrained into their thinking. Then, on the other hand, you've got a lot of really smart people who work at NASA, so you'd assume that these people could adapt and change the way they do things."

Running the Right Plays with the Right Team

There's little doubt that a number of people who have been with shuttle for their entire careers will retire at the close of the program. But that doesn't bother Garner when he considers the number of fresh, young and energetic team players who will get involved on Ares. The only hitch he sees in the plan's near future is the question of funding.

... from Garner's perspective as one of the quarterbacks (or project managers), it's all about the team, understanding your role, developing an action plan and producing a win.

"Can we keep it all going?" he wondered. "Despite all the rumors flying around, if we can just keep it all moving forward, we should be able to build [Constellation] and meet our goals."

So it really is like game strategy. And from Garner's perspective as one of the quarterbacks (or project managers), it's all about the team, understanding your role, developing an action plan and producing a win. Of course, he comes naturally to the athletic side of the analogy. How he wound up with a career on the shuttle program is another story.



A boy and his idol: Young Tim with Kenny Stabler at Stabler's football camp.

From Humble Beginnings

Tim Garner, the son of a railroad engineer and the city clerk for Gordo, Ala., grew up in a town smaller than most high schools these days. He was good in school, but even better at sports. He excelled in the big three — football, baseball and basketball. But football was his focus. After winning 24 games in a row at Gordo and the state championship, he entered the University of North Alabama on a football scholarship where he was a four-year letterman and took his team to the Division II National Championship game in 1986. (They lost to North Dakota State.)

He watched the coverage of the Apollo missions on the television with his family when he was a youngster. But during his college years, nothing was farther from his mind than a career in the space program. He remembers that the first shuttle flight he was ever really aware of was the Challenger accident.

"Everyone thought I was going to be a coach, but I was good at math and I thought I'd go into engineering," Garner explained.

His school, however, didn't have an engineering program. So he picked up a physics degree to go with the math. But he still didn't know for sure what he wanted to do with his education.

Or what the possibilities really were. He had a friend, though, whose father worked for a Safety & Mission Assurance contractor at Marshall, and this fellow got him the interview that set Tim Garner's career with the shuttle program in motion.

He got the job, moved to Huntsville in early 1989, and he's been working at Marshall on the shuttle program ever since with United Space Alliance and DP Associates. Along the way, Garner also picked up a couple more graduate degrees — a master's in operations research from the University of Alabama in Huntsville and a Master of Business Administration degree from the University of Alabama in 1997.



With his colleagues at his first job at Marshall Space Flight Center in 1989.

Obviously, driving for the end zone is second nature to Tim Garner. The pressure and excitement of the game's fourth quarter is also something he's extremely familiar with.

How Close We Really Are

"Now that we're in single digit shuttle flights, it's starting to hit home to a lot of folks how close we really are to the end of the program," Garner reflected. "People are beginning to ask, 'What kind of work will I be able to do on Ares? Will there be a job for me? If I spend all this time on making sure that we fly out the shuttle safely and close out the program properly, will I be rewarded or will I be left out on the street?' And that's why communications during this time is so important."

In addition to the skills-matching exercises to determine what shuttle has that Ares needs and building those databases and personnel profiles, the communications effort at Marshall is being upped with more town hall meetings, more work group discussions and more one-on-ones. It's all picking up speed — according to Garner, transition has become a reality that just can't be ignored.

It's all picking up speed - according to Garner, transition has become a reality that just can't be ignored.

But what challenges are on his immediate horizon?

"We're not getting rid of hardware as quickly as we anticipated because we have to keep flight spares for the final missions," he explained. "And I'm concerned that when it comes close to the end, there won't be as many people who want to stay on the close-out team because they'll look over at Ares, see the work going at full speed, and they'll make the move to get onto a more stable program. There might be a lot fewer people who will be motivated to work transition."

Garner won't be one of them, however. He's planning to stick with the shuttle program as long as it will have him.

"There will be opportunities," he said. "After the final shuttle has landed, there's going to be a lot of work remaining to close out the program. I have a lot invested in transition, and I'll be here to shut it down if Mike Allen wants me around."

Getting Ready to Launch the

There is no more-tangible proof that change is happening than when things begin to look different. Workhorse assets such as test stands at Stennis Space Center and the mobile launcher platform and launch pad 39B at Kennedy Space Center are now being converted and modified for Constellation Program use. These modifications could well be the physical evidence needed to convince a sometimes doubting workforce that the shuttle is retiring and Constellation is indeed real.

Some of the shuttle test stands and launch systems are already transitioning over to Constellation.

Firing Up for Constellation

Stennis Space Center has provided the Space Shuttle Program with valuable support in the processing of major flight components over the life of the program. No other workforce and no other facility possesses the capability and expertise required to certify space shuttle main engines for flight. Nor can any other NASA center claim the legacy of Stennis, having put rocket engines through their paces since the 1960s. The A-1 and A-2 test stands, in particular, have helped propel us into orbit.

Now, after almost a half century of test firings and the wear and tear of Gulf Coast hurricanes, the A-1 Test Stand is getting ready to start testing and certifying the engines that will carry us back to the moon and eventually to Mars. A-1 has already been transferred over to the Constellation Program, and the new A-3 Test Stand is rapidly rising alongside its sister test stands.

Gary Benton, manager of the J-2X program at Stennis, provided *Rendezvous* with the test stand back story. He explained that A-1 and A-2 were built for testing the Saturn II stage — a liquid oxygen tank and liquid hydrogen tank with five J-2 engines. All the engines that flew the Gemini and Apollo missions were stage tested there. To accommodate space shuttle main engine testing, the two facilities were modified to be engine — rather than stage — test stands. Testing began on the A-2 in the early 1970s and will continue through July 2009.



Stennis' A-1 Test Stand during a test firing of a space shuttle main engine.

The A-1 Test Stand was officially transferred over to the Constellation Program on November 9, 2006. Since then, modifications for J-2X engine testing have been ongoing. In early 2008, a series of tests on turbo machinery components were completed and now the A-1 Test Stand is undergoing additional program modifications to ready it for turbo machinery and engine testing beginning in 2011.

"In all, there are seven different development engines that will be tested, and at least four or five of them will have a path through A-1 at some point," Benton said. "We were actually supposed to begin testing in April 2010, but the test schedule was moved out due to budget constraints."

Initially, there were other power pack test series planned in 2006 to be tested on A-1 as early as 2009, to begin development of the Constellation-bound engine and decide what components they could use from the Saturn-era J-2X engine. Design changes caused the series to be canceled, however, so the team's been working on getting the stand in ship shape.

"What we're doing in the meantime, with a limited budget, is getting as much backlog maintenance done on the test stand as possible," Benton

elaborated. "You have to fix the stuff that's 40 years old or more, and you have to install the new equipment they need to test the new engines, such as a new thrust measurement system."

The thrust measurement system, which is necessary because the J-2X is a high-performance engine, is a modification that requires the removal and reinstallation of a large portion of the stand's structure and systems. In addition, a number of the vehicle systems need to be incorporated into the stand, such as the liquid oxygen and liquid hydrogen feed lines and the spin start systems — none of which were used for space shuttle main engine testing. Yet, with all the modifications scheduled, they're still looking at a minimum six- to eight-month gap in activity on A-1, which could prove costly if the gap widens further.

"You just don't want to mothball a test stand," Benton said. "The cost to bring it back up is significant and increases the longer it sits idle."

Add to that the issue of retaining the critical skills of the test conductors and the folks who operate the stand. There aren't too many places in the country that perform this kind of rocket engine testing, so there's a relatively small number of people who know how to do it.

Meanwhile, between now and June 2011 when J-2X testing is scheduled to begin, there will be plenty of activity at the A-3 site.

The difference between the A-1 and the A-3 stands will be considerably more than refurbished versus newly built. At first glance, the A-1 appears to contain actual battleship parts, including decking and hatches-its structure is steel and concrete, and its flame deflector is heritage. The A-3 will need no flame deflector, and its tower structure will look more open and be, of course, brand new.





Constellation's A-3 test stand begins to take shape at Stennis Space Center.

Benton explained that the structures and systems necessary to test sea level engine configurations on A-1 and simulated altitude (100,000 feet) engine configurations on A-3 are considerable. The engines on the A-1 stand will be tested without the nozzle extension. On the A-3 stand, the engine with its nozzle extension will be tested in a vacuum. In essence, the engine fires into a big pipe fitted with a steam injection system that creates a vacuum. According to Benton, this is a simple concept that will require the construction of a complex structure.

Ground was broken on the A-3 stand back on August 23, 2007, and the ceremony was attended by a host of local and state dignitaries. Actual construction of the stands structure began in fall 2008.

Two Programs, Sharing Assets

At Kennedy Space Center they're dealing with an interesting set of challenges regarding the transfer of the Mobile Launcher Platform-1 or MLP-1 and Launch Pad 39B over to the Constellation Program. Mike Stelzer, the project manager for all the ground systems at Kennedy that will support the Ares I-X flight test, talked about the scope of modifications to shuttle program equipment and facilities that had already been initiated, including work at the Launch Control Center and in High Bay 3 at the Vehicle Assembly Building. He also mentioned that they were encountering a number of first-time challenges in the transition from program to program.

"When Apollo came on it was all brand new facilities," Stelzer explained. "And then there was a fairly significant gap after the Apollo, Skylab and Apollo-Soyuz missions were finished. The keys were turned over and the modifications to the facilities and assets were achieved during that gap before the shuttle program picked back up in the late '70s and early '80s."

Stelzer's point was that this shuttle-to-Constellation transition was the first time these facilities would undergo modifications with one program getting ready for its first launch while an active program still had need of those same facilities. In an ideal world, the shuttle program would finish up, hand over the keys and then Constellation would begin its required modifications. Instead, there was the launch-on-need requirement for the Hubble Space Telescope repair mission, which required a second shuttle be ready for launch in the event that an emergency rescue was necessary.



The Mobile Launcher Platform-1 was officially turned over to the Constellation Program on March 25, 2009 at KSC.

Mods for the MLPs

In the interim, however, the transfer of assets is continuing on its own schedule. Ten days after the launch of STS-119, the MLP-1 was rolled over to the gate at pad 39B and a transition ceremony was held to formally hand over the asset — from last use on the shuttle program to first use for Constellation, which will be the Ares I-X flight test later this summer.

But before it even reached the gate, it was well on its way to being ready. Modifications to accommodate the new stack configuration that the mobile launcher platform would be carrying started months ago.

"Ares will use only one of the solid rocket booster exhaust holes, so we have to figure out if we could cover the other hole with acoustic water bags to damp any acoustic reflections [amplified sound vibrations] that might compromise the Ares vehicle," Stelzer said.

To do that, they needed to install additional water bag cleats. After putting the modification through shuttle's engineering and certification boards, they determined that the additional cleats would be acceptable for both programs. They were able to get that task done last summer. In order to make the most of the unexpected down time, Stelzer and his group looked at other non-interfering get-ahead work.

"A big item that popped out at us was that we needed to install a number of ground control racks to control the ground systems during launch, as well as racks that will communicate with and control the vehicle during launch countdown," Stelzer said.

They were able to get that done and complete the initial checkout tests as well. Some of the hardware was left in place during the STS-119 launch, but the ground control command and communication hardware, which was not designed to be part of the shuttle launch environment, was removed. Following the launch of STS-119, that hardware was reinstalled on the mobile launcher.

"Just being able to get that get-ahead work done in an early timeframe was important," Stelzer commented. "We mitigated a lot of risk in hooking up those systems and having them talk with each other and the firing room. It allows us to identify and rectify issues early on."

Geoffrey Husk, Ground Structural Systems engineer, reflected on the historical impact of transferring the equipment assets between programs. Both he and Stelzer agree that there was something of a shift in mindset, and that it wasn't necessarily negative. In fact, Stelzer sees the shuttle-to-Constellation transition activities at KSC as a positive sequence of events for both programs.

... having all this Ares I-X hardware down here, people are beginning to understand and believe that there's another program coming on.

"When you're told that your program is ending, and you're not seeing anything tangible for what happens beyond that, it's disheartening," he admitted. "But having all this Ares I-X hardware down here, people are beginning to understand and believe that there's another program coming on. They see the hardware. They see the modifications going on and they're less worried about being left hanging after shuttle retires."

Husk views the MLPs and the launch facilities as historical icons of the space program.

"You see the MLPs and you only know them as shuttle equipment," Husk said. "So when you think that the MLP will never launch another shuttle, but move on to launch a test rocket for a new program ... it's like wow. Those MLPs have seen every manned spaceflight we've ever done."

For the record, the mobile launcher platforms have been in service longer than Husk has been alive.

And this particular platform is considered to be the workhorse of NASA's mobile launcher platform fleet. It has launched 51 shuttle missions, three Apollo missions – including Apollo 11 – and three Skylab missions. It will go down in history as the first mobile launcher to support the Apollo, shuttle, space station and Constellation programs.

But what's a launcher to do without a launch pad?

The Conversion of 39B

The challenges inherent in transferring Launch Pad 39B over to Constellation can be characterized as complex, comprehensive, compressed and temporarily on hold. Pad 39B supported launch-onneed for the STS-125 Hubble Space Telescope servicing mission. Modification work came to a halt on pad 39B while the program waited for the mission to launch. Now that it's over, though, work is gearing back up.

That work actually began back in July 2007, when Ivey's Construction of Merritt Island began setting the foundations for the three 600-foot tall towers that, along with a system of catenary wires, comprise the pad's new lightning protection system. With the successful completion of the Hubble mission, the pad will be officially transitioned over for Constellation use and readied for the flight test of the Ares I-X later this year. Now its transformation resumes in earnest.

For Steve Bulloch, pad manager for the Space Shuttle Program, the tasks ahead present a



Launch Pad 39B with its three lightning protection system towers.

threefold challenge.

"We have to keep the pad shuttle-ready to support launch-on-need, support Constellation's Ares I-X flight test, and prepare the facility for

"We have to keep the pad shuttle-ready to support launch-on-need, support Constellation's Ares I-X flight test, and prepare the facility for Constellation's future missions," Bulloch said.

The pad's configuration will not require heavy structural modification for the Ares I-X flight test — other than the adaptation of two access arms to facilitate launch processing and the installation of a vehicle stabilization system. But when the Constellation program modifications are completed, it will have undergone much more than a mere facelift. The dimensions of a shuttle stack and an Ares stack differ significantly. The shuttle stack is only 184.2-feet tall; the Ares rocket with the Orion module on top will tower 300-plus feet above its perch on the mobile launcher — well out of reach of the launch pad's fixed and rotating service structures, which provide cargo integration, crew access and launch operations access to a shuttle stack.

... when the Constellation program modifications are completed, it will have undergone much more than a mere facelift.

"Before we take possession of the pad, United Space Alliance, as part of the pad B Shuttle Program closure, will decommission the pad," said José Perez Morales, pad senior project manager for the Constellation Program. "They will remove the systems that won't be needed for Constellation, safe them and make sure that there are no hazardous materials left."

Then, early next year Constellation will start with the transformation of pad B in support of the Ares I vehicle. First, the fixed and rotating service structures will be taken down. Then most of the cables in the pad will be replaced with fiber optics in support of the new Constellation Program electronic system. By 2011, they'll be installing a new emergency crew egress system to replace the old gondola and zip line system. Between 2011 and 2013, when Perez-Morales is scheduled to turn the pad over to launch operations, they'll install new elevators and modify all the interfaces between the pad and the mobile launcher platform. The last task is to do whatever minor infrastructure repairs are necessary to the pad slopes and, perhaps, modify the sound suppression system.

For Perez-Morales, the biggest challenge is the compressed schedule caused by the delays of the shuttle's Hubble mission and the Ares I-X flight test. He said that they've lost close to a year in pad development, so a lot of modification activities will have to happen simultaneously.



An artist's depiction of Launch Pad 39B configured for the Ares I.

"We will coordinate everyone and make sure that everybody working on the pad has the time to do their work and not interfere in anyone else's modification work," he explained. "I'd say that, looking at it right now, the coordination of work complicated by the schedule compression is our biggest challenge."

From Bulloch's perspective, the challenge doesn't seem quite so daunting. But then he's focused more on the short-term — namely supporting the shuttle on the pad at the same time as preparing for Ares I-X. He allows that it will require a major integration effort, but takes comfort from the fact that the team will remain somewhat intact.

"We have this standing set of people," he said. "We're going to support launching shuttle, prepare the pad for Ares I-X and safe the pad for its release to Constellation. It'll be all the same workforce, the same engineers and technicians."

In the grand scheme of the space program, Bulloch looks at this transition from shuttle to Constellation as just another modification period with a different set of people doing the project management.

"I've got a set of requirements that I then go and execute, coordinating between my workforce and my fixed-price contractors, to support the pads on a day-to-day basis," Bulloch said. "But KSC is a fairly closed loop and a lot of us have been here a long time. We wind up working with the same people again and again in different capacities."

In the end, Bullock thinks it's perfectly logical and no surprise at all that most of the people working on Constellation modifications on the mobile launcher platform and the pad used to work on shuttle. After all, there's no other workforce that is better qualified, is better acquainted with the territory and has a decades-long commitment to the launch ground operations of the space program.

Weighing In



lips & Quotes

What was particularly interesting about the focus and brainstorm sessions — or FABS — that we conducted at Marshall Space Flight Center and Stennis Space Center for this issue, was that we could tell by the tone of the groups that the close of the program is fast approaching and their concern for their futures is increasing. Like many of the sessions *Rendezvous* has conducted in the past, we talked with both civil servants and contractors about how they're handling shuttle transition and retirement. All groups were asked the same questions.

- Can you think of any communication or action that would help ease shuttle workforce uncertainty or anxiety during the next 18 months?
- Have you been taking advantage of human resource initiatives put in place to address transition and retirement issues? If so, what have you done, and how has it helped?
- Do you have any unanswered questions regarding the closeout of the shuttle program?
- What would be meaningful to you as a memento of the shuttle program, and how would you like to receive it?
- What do you think the American public and the world at large should know about our space program?
- When you watch a launch and monitor the progress of a shuttle mission, what are you thinking and feeling?

Can you think of any communication or action that would help ease shuttle workforce uncertainty or anxiety during the next 18 months?

"We want to know what our next step needs to be. We're very comfortable here, and we're all dedicated to staying focused on flight safety for the shuttle's remaining flights, but it's what's next that's uncomfortable ... And for the contractors, no one's got their backs."

"I think we need to get our [NASA] administrator in place and then get clear direction. We've had a lot of different directions communicated. Let's get a consistent one."

"Our biggest stressor is not knowing."

"We're working toward the previous plan from the previous [presidential] administration. We have a new administration now, and we need to have his endorsement or his new plan."

"If shuttle ends and Constellation runs into a show stopper, what then?"

"Ares is still immature. We have a five-year gap, and some of the technical issues could be show stoppers. If shuttle ends and Constellation runs into a show stopper, what then?"

"We've got a history of shutting down programs. What if they pull the plug on Constellation?"

"The agency needs to incentivize the people we need to keep. There are some people we need so much on shuttle, that we won't let them transition to Constellation."

"As contractors, we're just looking to win the next contract. This is the first time that I'm actually concerned about my job."

Have you been taking advantage of human resource initiatives put in place to address transition and retirement issues? If so, what have you done, and how has it helped?

"Some people got the idea that if you went [to a two-day training class] that it meant you were looking for another job. And no one wanted their managers to hear that, so they started dropping out."

"Our managers have talked with us and made suggestions, one-on-one."

"We've been offered retention packages."

"I'm looking at not just where I could go in the Constellation Program, but if there are other government agencies that could use my skill mix."

"I'm impressed with human resources and with our managers. There's been a lot of effort for this transition and there didn't have to be."

Do you have any unanswered questions regarding the closeout of the shuttle program?

"Where's the grid that shows us where the available jobs are?"

"Some of the people in this room won't be here in fiscal 2011. Space Operations Mission Directorate will have operations needs too, not just Ares. So what are those jobs going to be?"

"The people who know the answers are the people who are already charging to Constellation."

"Space Operations Mission Directorate will have operations needs too, not just Ares. So what are those jobs going to be?"

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- "What's in it for me to stick with the shuttle program or transfer to Constellation?"
- "How much confidence do we really have that our leaders are walking the talk?"
- "I'm worried about what we're bringing forward into the next program. It seems like we're sticking with processes without understanding why we use those processes."

What would be meaningful to you as a memento of the shuttle program, and how would you like to receive it?

- "A shadow box with all the mission pins, or at least a picture of all the pins ... maybe a silver coin featuring the shuttle."
- "I'd like one big party at the end."
- "Can I have an orbiter?"
- "I'll take ten more flights."
- "A piece of flown hardware melted down into a ring would be great."
- "Something off the orbiter from the last flight."
- "Tile."
- "Something flown."
- "A turbine blade."
- "Something from the area or discipline you worked in."

What do you think the American public and the world at large should know about our space program?

- "They need to learn how they've benefitted from the shuttle program."
- "People don't understand the technology that has come out of the space program or how little is actually spent on it."
- "People aren't paying attention to space because of everything else going on in the world."
- "The public doesn't get enough information on our space program. They can take it or leave it."
- "The spinoffs that come from the space program need to be shoved down America's throat."



"When I came into the program, I had no clue about the level of effort that goes into getting the shuttle up. I think the American people don't know what it takes."

"They don't realize that so many things in their personal lives came from the space program."

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When you watch a launch and monitor the progress of a shuttle mission, what are you thinking and feeling?

"Sometimes when we launch, those eight minutes [before main engine cut off] scare the hell out of me. I mean, I ain't looking anywhere else. You know if there's another accident, shuttle is over."

"I'm thinking that shuttle is such a great place to work; I don't want to leave it."